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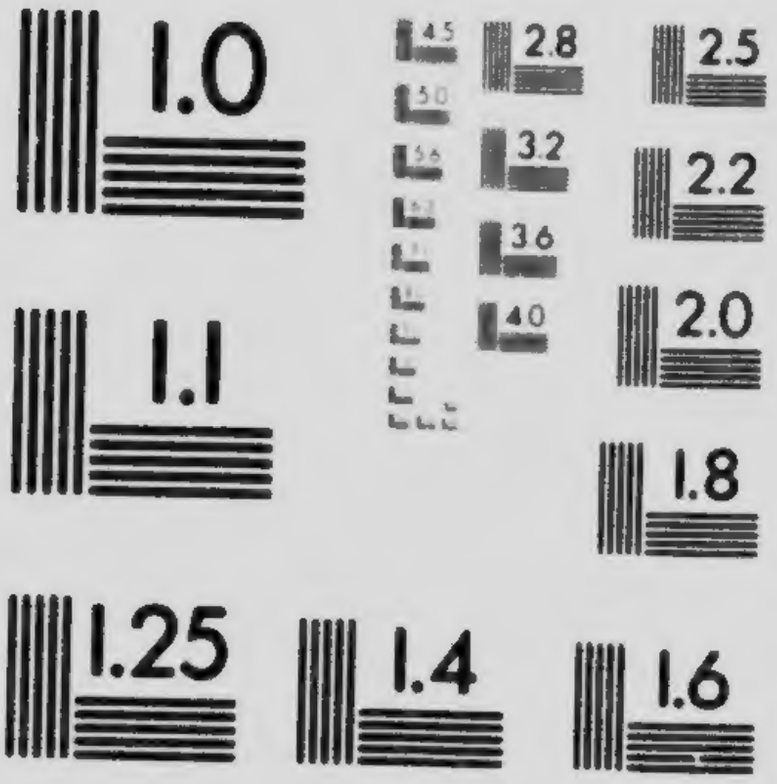

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J. B. Tyrrell.

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NOTES ON THE PLACER MINES OF CARIBOO, BRITISH COLUMBIA.

J. B. TYRRELL.

In a brief trip made to the placer mines of the Cariboo district, British Columbia, in the summer of 1918, some data were gathered pertaining to the distribution and geological features of the auriferous gravels, particularly in regard to the existence of extensive beds of pre-glacial gravels below Glacial deposits, and the greater influence of stream piracy over glaciation in changing the courses of streams. They are here presented in the form of brief notes.

It is not my intention to describe the configuration of the country, the details of its geology, or the extent to which it is being mined. The Geological Survey of Canada began a survey of the area last summer, and intends to continue it until it is able to publish a complete report with detailed maps of the geology and structure of the country, not only of the older rocks which underlie it, but also of the later formations and of the influences to which it has been subjected to form its mountains and valleys, and to deposit the gold in the bottoms of these valleys.

Mr. Bowman, of the Geological Survey of Canada, made an examination of the country some years ago and published a number of good maps of the whole district, and of several of the gold-bearing creeks. With these he published a report on the older rocks underlying the country. Possibly the material pertaining to the gravels collected by Mr. Bowman may be incorporated in the report which is now to be published by the Geological Survey.

HISTORICAL DEVELOPMENT.

For many years the country was surrounded with a halo of glory and mystery. Discovered in the winter of 1860–61 by prospectors travelling overland through the rugged mountains to

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the south, over which it was almost impossible to transport supplies, and on which the hardy frontiersmen were obliged to depend for food on the caribou that roamed through the forests, it was indeed a difficult country to reach, but after it was reached the rewards to the pioneers were great. Writing in the autumn of 1861 Governor Douglas says that he had met a large number of men who had returned from the new gold camp, and without exception they had all been successful, a statement which cannot be made for many camps.

After gold had been discovered at the Cañon on Williams Creek by William Dietz (Dutch Bill) word was quickly passed back to the prospectors scattered along the Fraser River and they soon made their way to the new Eldorado. In 1862 and 1863 many parties came in from the south and also across the plains and mountains from the east until a few years later Barkerville, the center of the new district, was second only to Victoria in population in what is now the Province of British Columbia.

Since 1858 up to the end of 1917 the Government Reports show that British Columbia produced about $75,000,000 worth of placer gold. Of this amount the Cariboo country, not including the Quesnel district, produced gold to the value of $41,500,000. I have not at hand the details of the various creeks, but probably of this total, Williams Creek may have produced about $25,000,000 and Lightning Creek $5,000,000. Mr. Muller informed me that Williams Creek above the Cañon produced about $1,000 to the running foot and below the Cañon, for a couple of miles, about $600 to the running foot. Most of this was produced from shallow ground, where the whole material from the surface downwards to the bottom of the paystreak was shovelled into sluice boxes, in which the lighter sand and gravel were carried away by the water, while the heavier gold was left in the riffles.

In the bottoms of some parts of the valleys the alluvial deposits were too deep to be handled in this way, and there shafts were sunk to bed rock, and drifts were run on or in bedrock

through which the rich gold-bearing layers was extracted and washed in sluice boxes.

Unlike the conditions in the mines of the Klondike the gravels here were not perennially frozen, and consequently water was usually present in great quantity. The unwatering of the deeper mines was therefore a serious and expensive problem and with greater increase in the depth of the overburden, water finally rendered the deep ground unworkable. I could not learn of any individual instance where miners were actually driven out of rich pay gravel which they were mining, by water, but exploration and development of deep ground have undoubtedly been stopped by water, even where rich prospects were obtained. The question therefore at once arises, how much valuable gold-bearing ground is there still in the district awaiting cheaper transportation, and larger and more energetic mining methods.

TOPOGRAPHY.

On the east is a high rugged range of mountains rising in jagged peaks to heights of about 7,000 feet. This range limits the known gold-bearing area in that direction. West of it are more detached mountain masses, rising in some peaks like Mount Agnes or Bald Mountain, to heights of 6,200 feet, while farther west the country declines in a series of high transverse ridges separated by deep valleys towards the main valley of the Fraser River. The tops of the higher mountains above the elevation of about 5,000 feet are open moorland on which the snow lies until well on in the summer, but below this level the slopes are thickly wooded with fine forests of spruce and balsam, many of the trees in which, in the vicinity of Stanley, would average 18 to 20 inches in diameter, while some are as much as 31 inches. Fortunately forest fires do not appear to have swept over these mountain sides to the same extent as they have swept over many of the forested areas in eastern Canada.

CONDITIONS AND DEVELOPMENT OF DRAINAGE.

The underlying rocks are mostly schists and slates which have been called by Bowman the Cariboo Schists, and the prospectors

from Ontario would be struck with the resemblance of these schists to the Keewatin Schists of the northern portion of their own Province, or miners from the Klondike might consider them the Klondike Schists which Mr. McConnell has so well described in "The Klondike Gold Fields." Many quartz veins have been found running through these schists holding gold in appreciable quantities, but as yet none have appeared to deserve serious development under the difficult conditions of transportation still prevailing in that country. These schists are doubtless of Pre-Cambrian or early Paleozoic age, and the mountains of

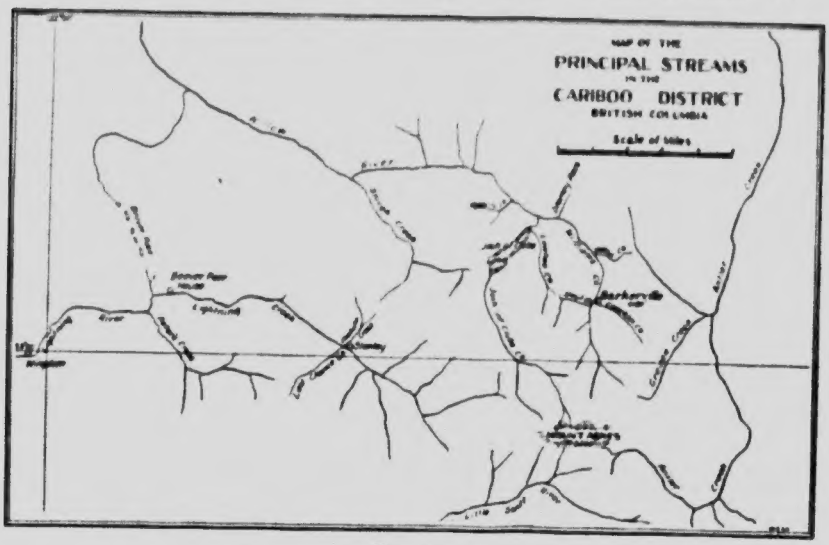

FIG. 22.

which they are composed may have been formed during several succeeding periods of uplift and disturbance, the last of which may possibly have occurred since Oligocene times. In this case an additional point of touch with the mountains of the Klondike would be indicated, as these latter include in their folds beds of Miocene or Oligocene age.

Subsequent to the final period of mountain building a long epoch of erosion set in, during which valleys were developed

radiating from the important mountain masses in all directions. Of these mountains, Mount Agnes or Bald Mountain, is the most conspicuous. From it Little Swift River flows to the south, Grouse and Antler Creeks to the east, Williams and Jack-of-Clubs Creeks to the north, and Lightning Creek to the west. It is impossible not to recognize the marked resemblance of this central point to the Dome at the head of Bonanza Creek in the Klondike. It is true that Mount Agnes is 2,000 feet higher above the sea than the Dome, but the bottoms of the surrounding valleys are also about 2,000 feet higher than the valleys that radiate from the Dome and as both sets of valleys are of about the same depth, with sloping wooded sides, the general similarity of the natural features of the two districts is quite striking.

Williams Creek.—While the valleys were being formed the streams did not always follow their present water courses. For instance, the valley of Conchlin Gulch which comes from the southeast, crosses Williams Creek, and is continued as Stout Gulch and Lowhee Creek until it opens into Slough Creek as a hanging valley. Between what is now Conchlin Gulch and Stout Gulch the present drainage is crossed and intersected by Williams Creek, the lower portion of which is therefore of later age, though the upper portion was probably originally a tributary of Conchlin Creek. Consequently the old wash of this old Conchlin-Stout-Lowhee Gulch is of a greater age than the gravel in the bottom of the lower part of Williams Creek, and the stream which once flowed in it was older than the latter creek. The drainage down Conchlin-Stout-Lowhee Creek must have persisted for a comparatively long time, as the old valley is wide and mature, though the present creeks have cut narrow gorges in the bottom of its floor.

The main valley of Williams Creek at that time extended up Valley Creek, and down Willow River. Then one of its tributaries from the south, which extended up past the present site of Barkerville, cut into the side of Conchlin-Stout-Lowhee Creek, and robbed it of its water, drawing the gold-bearing gravel with it down into that portion of Williams Creek below the Cañon.

From that time onwards Conchlin Creek discharged into this newer part of Williams Creek, and Stout Creek developed a gorge (Plate X., *a*) in the upper part of the abandoned Stout-Lowhee valley in which it flowed eastward into Williams Creek, instead of northwestward as before.

But stream piracy did not end in the robbing of the water of Conchlin-Stout-Lowhee Creek by Williams Creek. Slough Creek for some reason deepened its channel and formed a great wide valley (Plate X., *b*), the floor of which was about a third of a mile across. It must have cut back and robbed the water from the Williams-Willow river, for Jack-of-Clubs lake, which lies in its valley, is reported to be 200 feet deep, and the bedrock in its valley a little farther west was found by drilling to be 287 feet below the surface, while the lowest part of the bedrock in the valley of Willow River was only 102 feet below the surface, which was probably a little higher than the surface at the drill hole near Slough Creek. Thus the original bedrock bottom of the valley of Slough Creek is nearly 200 feet deeper than that of Willow River, and consequently it undoubtedly robbed the water from the latter stream.

In excavating its great valley the old Slough Creek, which had doubtless become a large and important river through the addition of Williams Creek, and probably also of Valley and Downie-Pass Creeks, cut away the lower portion of the almost abandoned valley of Lowhee Creek, and of the wide valley of Jack-of-Clubs Creek, reducing them to hanging valleys on the side of the master valley. The original courses of the lower parts of the streams that occupied these two old hanging valleys was not apparent, but it is possible that they turned westward and then southwestward in what is now the valley of Chisholm Creek, and thus flowed into Lightning Creek, for the upper portion of Chisholm Creek valley was also cut away by Slough Creek.

Lightning Creek.—Lightning Creek valley is narrow and V-shaped as far down as Stanley, the narrow channel in its rock floor being often not more than 20 or 30 feet in width. At Stan-

a

a. Mouth of Stout's Gulch from William Creek showing tailings from hydraulic operations in the foreground, and gorge in the bottom of the old mature valley in the back center

b

b. Wide Valley of Slough Creek looking northwestward from Mosquito Cr.

c

c. Cliff of boulder clay from bedrock to surface on Stout's Gulch.

ley the wide U-shaped valley of Chisholm Creek joins it from the north, and thence downwards the whole valley is wider than before, and maintains a U-shaped character. At a place known as the Beaver Pass the main valley swings off to the north, and doubtless the drainage ran for a long time in that direction, but the present stream turns southwestward into a narrow gorge between rocky walls, and continues in it past Wingdam towards its junction with Swift River to form Cottonwood River. Close to Beaver Pass Peters Creek flows into Lightning River from the south, and whether the narrow valley of Lightning Creek below the confluence of these two streams was once the continuation of its valley, or was the valley of a tributary in which the drainage has been reversed, is uncertain, though the latter supposition is probably the correct one. I was not able to learn the depth of bedrock below the surface at Beaver Pass, but it is probably several hundred feet, for according to information received from Mr. M. Bailey, the depth from the surface to bedrock about four miles farther up Lightning Creek is 205 feet, and while the grade of the surface between the two places is very light, the grade of the bedrock is probably much steeper.

This will indicate the conditions of drainage, and the characters of the valleys that had been formed by it at the end of the Pliocene Period, and it will be seen that in pre-Glacial times wide mature valleys had been formed, but stream piracy had been taking place and the streams that formed these valleys were robbed by other streams that flowed in deeper valleys.

Accumulation of Gold.—During this time gold was being concentrated into the bottoms of some of these valleys in larger or smaller quantities, according to the abundance of th supply, the excellence of the bedrock for forming riffles, or the length of time through which the concentration was operative. If similar conditions had continued down to the present there would have been several wide valleys in the district with beds of gravel covering their bottom lands, through which paystreaks would run. Deep narrow V-shaped valleys and gulches would discharge into them, sometimes from hanging valleys, while in embayments

along their sides would probably occur gravel-covered erosion terraces.

The continuity of conditions of erosion was suddenly broken by the advent of the Glacial Period. There was no general Cordilleran glacier in this district with a motion southeastward or northwestward parallel to the trend of the mountains, but the country was heavily glaciated by local glaciers that flowed down from the mountains into the great valleys. On the side of the mountain north of the valley of Lightning Creek near Stanley, and 1,000 feet above the stream, a quartz ledge was seen to be scored by glacial markings trending northwestward parallel to the course of the valley.[1]

After existing for a long time, and in some cases extending far out over the plateau, even to the banks of the Fraser River itself, the local glaciers retired and disappeared, leaving behind them extensive sheets and deposits of boulder-clay, and large moraines; the latter dammed many valleys and diverted streams into other channels, thus adding to the intricacies of a drainage system which was already quite complicated in pre-Glacial times.

Most, if not all of the valleys had beds of pre-Glacial gravel of varying thickness covering their rocky floors. As the glaciers moved down the valleys they in many cases rode over this gravel and left it, with its cargo of gold, comparatively undisturbed, and at the same time they brought down a certain quantity of material from the hills on each side and formed ground moraines of hard massive impervious boulder-clay, which, on the retirement of the glaciers remained as watertight covers of varying thickness over the underlying gravel. Existing streams usually flow on the top of this bed of boulder-clay. In some narrower and swifter places in the upper reaches of valleys they have doubtless cut through it to the underlying gravel or bedrock, and many of the earlier mining operations were probably carried on in places where this had occurred. In these places all the gravel down to bedrock, as well as the upper part of bedrock

[1] "Was there a Cordilleran Glacier in British Columbia," by J. B. Tyrrell, *Jour. of Geol.*, Vol. 27, No. 1, 1919, pp. 55–60.

itself, was shovelled into the sluice-boxes, and washed to recover the gold.

In those parts of the bottoms of valleys where boulder-clay was still lying undisturbed on the gravel the miners sank shafts through the boulder-clay and gravels to bedrock, drove tunnels on or in bedrock, pumped the water from them with Cornish pumps, and extracted the gold-bearing gravel from the shafts. As the gravel was usually porous, the flow of water was often large and difficult to handle with the pumps. In fact, in long stretches of several of the valleys, where the pre-Glacial gravels have been buried to a great depth it has been found impossible to mine, or even to explore them on account of the heavy flow and heavy pressure of water encountered. Further attempts will doubtless be made to explore these deep gravels, but if such enterprises should be undertaken there should be made careful physiographic surveys of the district in order to determine the particular valleys or parts of valleys into which most gold was discharged, and the localities in which it probably lodged.

An interesting feature was observed on some of the gulches tributary to the larger valleys, as for instance on those of Mosquito and Last Chance Creeks. Both these streams flow in channels bounded by rock on their western or down-stream sides, and boulder-clay on their eastern or upstream sides. In searching for a paystreak in each case the old miners found that the pre-Glacial channel was buried beneath the boulder-clay on the eastern side of, and at considerably lower level than, the present stream, for the glaciers, as they descended the main valleys, had filled the upper sides of the gulches with boulder-clay, and, when drainage was re-established in post-Glacial times, the new channels were formed above and to the west of the old ones.

At the Cañon on Williams Creek, where two narrow gorges have been cut on opposite sides of a rocky knoll, the direction of movement of the glacier would appear to have been more or less transverse to the course of the stream at this point, and the glacier completely filled and covered up the eastern of the two gorges with boulder clay, so that it was not until some little time

after mining was begun on the creek that this gorge was found and uncovered.

The valleys so far referred to have had beds of pre-Glacial gravel remaining in them, but two valleys, or possibly parts of one valley, which came under my notice, namely, Stout-Lowhee and Chisholm Creek valleys, were different from the rest in this particular, for either most of the gravels which had originally covered their floors had been removed before the advent of the glacier, or possibly the glacier itself may have displaced what remained of the gravel, and may have kneaded it up with material brought from elsewhere to form the boulder-clay which is now either resting directly on bedrock, or is separated from it by a thin layer of poorly assorted material (Plate X., *c*.) This absence of gravel between the boulder clay and the underlying rock is well shown in a long tunnel into the western side of the valley of Chisholm Creek. Also the hydraulic operations which were being carried on in Stout Gulch at the time of my visit exposed an excellent section of boulder clay, which seemed to be fairly homogeneous from top to bottom. Some of it was slightly auriferous. On Mosquito Gulch, where hydraulic operations were also being conducted, and where boulder-clay along with both overlying and underlying gravel was being broken down and washed through sluice boxes, some of it was decidedly auriferous.

In addition to forming a blanket over the earlier gold-bearing gravels the boulder-clay would appear to have been deposited in some places of sufficient thickness to divert streams into new channels, as for instance at Beaver Pass House, Lightning Creek has been diverted to a narrow western from a wide northern channel, probably on account of the deposition of a thick bed of boulder-clay in the latter.

In addition to the deposition of a bed of boulder-clay over most of the surface of the lower land the glacier formed terminal moraines across the bottoms of the valleys. One of the most conspicuous of these is in Slough Creek valley, and extends from the west end of Jack-of-Clubs lake for several miles westward to a point some little distance below the mouth of Devils' Creek.

This moraine blocks the drainage of the valley, and forces the water issuing from Jack-of-Clubs lake to flow down the valley of Willow River.

Another hilly and stony moraine lies in the bottom of the valley of Lightning Creek between the mouths of Chisholm and Davis Creeks, but it had no influence on the general drainage except temporarily to dam back the water into a small lake.

Altogether the diversion of drainage from one valley to another would seem to have been affected much more by stream piracy in pre-Glacial times than by moraines or other dams in Glacial or post-Glacial times.